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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
IDAHO OPERATIONS OFFICE
950 West Bannock Street, Suite 900
Boise, Idaho 83702

July 3, 2013

CERTIFIED MAIL – RETURN RECEIPT REQUESTED

Ms. Kris McCaig
Teck America Incorporated
501 N Riverpoint Blvd., Suite 300
PO Box 3087
Spokane, Washington 99220-3087

RE: Draft Quality Assurance Project Plan for the Bossburg Flat Beach Refined Sediment Study, Upper Columbia River Project

Dear Ms. McCaig:

On February 26, 2013, the U.S. Environmental Protection Agency received the draft Quality Assurance Project Plan for the Bossburg Flat Beach Refined Sediment Study, Upper Columbia River Project from Teck American Inc. EPA's comments on the document are attached. These comments have been submitted previously via email on July 3rd. This represents a formal submittal of these comments for the administrative record.

If there are any concerns regarding this letter, you may contact me at 208/378-5760.

Sincerely,

R Matthew Wilkening

R. Matthew Wilkening
Upper Columbia River Project Manager

Enclosure

cc: Dan Audet, U.S. Dept. of Interior
Patti Bailey, Confederated Tribes of the Colville Reservation
Randy Connolly, Spokane Tribe of Indians
John Roland, WA Dept. of Ecology
Laura Buelow, EPA-Hanford Office, email only
Dennis Faulk, EPA-Hanford Office, email only

EPA Comments on the
Draft Quality Assurance Project Plan for
Bossburg Flat Beach Refined Sediment Study, Upper Columbia River Project

General Comments:

1. In the LOE letter of November 15, 2012, EPA required Teck America Incorporated to characterize the vertical and horizontal extent of sediment and soil contamination in the areas of the Young American Mill site and Bossburg Flats. While TAI did provide a sampling plan for the sediment in these areas, there was no discussion of soil sampling. Soil sampling should be included in this QAPP. To provide some guidance regarding this sampling, SRC, a contractor for EPA, developed a soil study memo which is attached. This report will have to be reviewed to insure that soil sampling as well as sediment sampling is included in the text. Also, the title of the QAPP should be revised to include "And Soil" after the word "Sediment".

2. In regards to the sediment sampling, TAI should have considered documents developed to support previous sediment sampling efforts, e.g., 2009-11 Beach Sediment Sampling Data Quality Objectives. For guidance, a sediment sampling memo is also attached that uses the Beach DQO document as a framework for sampling the sediment in the study area.

3. Currently EPA does not recognize an IVBA method for As. All previous analysis at the Upper Columbia River Project for in vitro bioavailability analyses has been for Pb for which EPA used Method 9200.1-86. In regards to bioavailability for As, EPA uses a default bioavailability value of 0.6. This is consistent with Region 10 policy which has recently been accepted by EPA nationally. See:

http://www.epa.gov/superfund/bioavailability/pdfs/Transmittal%20Memo%20from%20Becki%20Clark%20to%20the%20Regions%2012-31-12.pdf

The text should be revised to reflect this.

Specific Comments:

1. P. A-1, section A4.1, page A-4; A5, p. A-5; A7.1, page A-6; section B1, page B-1; and Appendix A, Introduction, second paragraph: the text reads as though the contamination at Bossburg beach to Evans campground is due to mining activities at YAM. This is particularly evident in the Appendix overview first two sentences which imply that Evans beach contamination is due to YAM. This conclusion cannot be substantiated and the text should be removed. Based on data produced by other studies, there is a suite of methods available to evaluate whether metals present in various sediment textural classes involve Teck wastes. Source analysis may become important when interpreting results and/or determining if suspected local secondary sources may be contributing metals to this specific portion of the river, such as the YAM and Bossburg areas. Thus, the discussion of the attribution of contamination should include the Trail Smelter or such discussion should be eliminated from the text.

2. P. A-5, Section A5. The following text should be added to this section:

> "The sampling of sediment and soil in the area of the Young American Mill Site, Bossburg Flats, and Evans Campground Beach is focused on a relatively small portion of the Upper Columbia River site. The intent of this effort is to gathered detailed information for a human health risk assessment. However, the data gathered will be usable in the RI/FS for the eco-risk assessment.
>
> The data gathered in this investigation is useable for the eco-risk assessment, in part, because the all of the detection limits in the Bossburg QAPP are acceptable for use in the sediment ecological risk assessment. In regards to the soil samples, all of the detection limits are acceptable except for selenium where the MRL of 1 mg/kg is higher than the ecological soil screening level (EPA's EcoSSL) for terrestrial plants, which is 0.5 mg/kg (all are dry weight concentrations). But to date selenium has not been found to be a COPC. The lead MRL of 0.05 mg/kg is essentially equal to the EPA EcoSSL for mammals of 0.053 mg/kg lead. However, lead is commonly found at concentrations much elevated compared to this value so this detection limit should not pose an issue either."

3. P. A-7, Section A7.2. A second DQO, the determination of the spatial extent of contamination, should be added to this section.

4. P. A-8. Figure A7-2. This figure incorrectly locates Young America Mill Site. In addition, no soil sampling sites are included in this figure. The size of the individual sampling areas and the distances between sampling areas cannot be determined from the figure because the various scales on the figure do not agree with one another (see the attached DQO memos for additional guidance on sampling.)

5. P. A-8, Section 7.4.2. EPA disagrees with the designation of the site boundaries for this investigation being restricted to the near-shore sediment. See General Comment 1.

6. P. A-8, Section 7.4.3. EPA agrees this sampling event should occur during a period of reservoir draw down. However, based on the hydrograph and additional information showing average reservoir elevations in the spring, fall and a maximum elevation as plotted in the attached Figures 1-5, the sampling should occur during the spring draw down. As indicated by the historical data presented in these figures, sampling during the spring draw down insures that a boat will not be required for the sampling effort which, in turn, should help insure the completeness of the sampling effort.

7. P. A-9 and A-10, Section A7.6.1. A sampling technique should be included that can track potentially narrow regions of contamination quickly and easily. XRF would be such a technique. When areas of potential contamination are indicated by XRF, a sampling program should be developed to perform confirmatory laboratory analyses. This technique should be discussed in

section A7.6.2 also. Any application of field XRF should include specifications for sediment or soil handling and processing steps. In addition, areas of concern can be identified for possible core sampling.

8. P. A-10, Section A7.6.2, 2nd parg. Either provide the value for the sufficient volume of material necessary for the full set of analyses or provide a reference to where such information can be found.

9. P. A-11, Section A8, last sentence second paragraph. EPA's Forum on Environmental Measurement (FEM) Policy requires the assurance of competency of laboratories, field sampling and other organizations generating environmental measurement data for the Agency. Therefore, NELAC and other proof of lab and field competency through accreditations and other certifications are required. The QAPP should be corrected accordingly.

10. P. B-3, Section B1.2. It is important that the sampling procedures be more similar to the sampling process used to collect the beach sediment in order to insure a better comparison between data sets. Accordingly, SRC, a contractor for EPA, developed the attached refined sediment study memo. After Teck has reviewed the memo please contact us to discuss this proposed modification to the sediment sampling. (See General Comment 2.)

11. P. B-4, Section B1.2, Sampling Methods, 1st parg. Add the following text, " in consultation with the EPA field oversight crew" after ". . . necessary corrective actions . . ." in the first sentence.

12. P. B-4, Section B.3. The last line states that the lab will not dispose of the study samples until authorized to do so by the analytical chemistry laboratory coordinator. Note that such authority rest with the EPA. The text should be revised to reflect this.

13. P. C-1, Section C. The text states "This study will rely on the knowledge and expertise of the TAI technical team. The field team and laboratory will stay in close verbal contact with the senior technical advisor and the task QA coordinator during all phases of this study. This level of communication will serve to keep the management team appraised of activities and events, and will allow for informal but continuous task oversight." A more meaningful description should be provided such as regular meetings.

14. P. C-3, Section C2, last paragraph. Include the time period with in which the validated data will be provided to EPA.

15. P. D-2, Section D2. The QAPP specifies that 10% of the chemistry data will be fully validated (Stage 4) including the first two data packages generated for each chemical analysis type. The documentation/deliverable requirements from the laboratory as listed in Section A9.2, pp A-12-13, Chemistry Laboratory Documentation and Records of the QAPP, however, are not sufficient to conduct a full or Stage 4 data validation. Based on the list provided, only up to a Stage 2B

data validation can be conducted with the lab deliverables. Section A9.2 and instrument output and raw data need to be revised to reflect this.

16. Section D2. The QAPP specifies that ESI will conduct data validation. However, it is not clear on page A-13, Section A9.3, Data Quality Documentation, who will be responsible for the completion of data validation and data quality assessment. Also, this section states that the data validation reports will be prepared and provided to the laboratory QA Manager instead of directly submitting the report to the PM or the task QA coordinator (if sub-contracted) It is not clear why this is so. An explanation of why the lab QA Manager is the recipient of the reports should be provided. Section A9.3 needs to be corrected as necessary.

17. Columbia Analytical Services (CAS) is required to submit the SOP they will follow for sieving and partitioning sediment samples to <2 mm and <250mm and also the SOP for all the analyses listed.

18. Appendix A should be rewritten to include XRF screening, confirmatory sample collection and laboratory analysis.

19. Bossburg Flat and Evans Campground are more readily accessible by vehicle than by boat. Appendix A should specify which sampling areas are to be reached by boat and which sampling areas are to be reached on foot. Note if, as recommended, sampling occurs during the spring draw down it is anticipated there will no need to use boats for sampling.

20. SOP-2. The section, Sample Labeling, will require rewriting to describe XRF sample labeling and confirmatory sample labeling.

21. SOP-3. The section, Sediment Sample Collection, will require rewriting to include XRF sample collection.

22. Attachment A3 will require examples of XRF sampling forms.

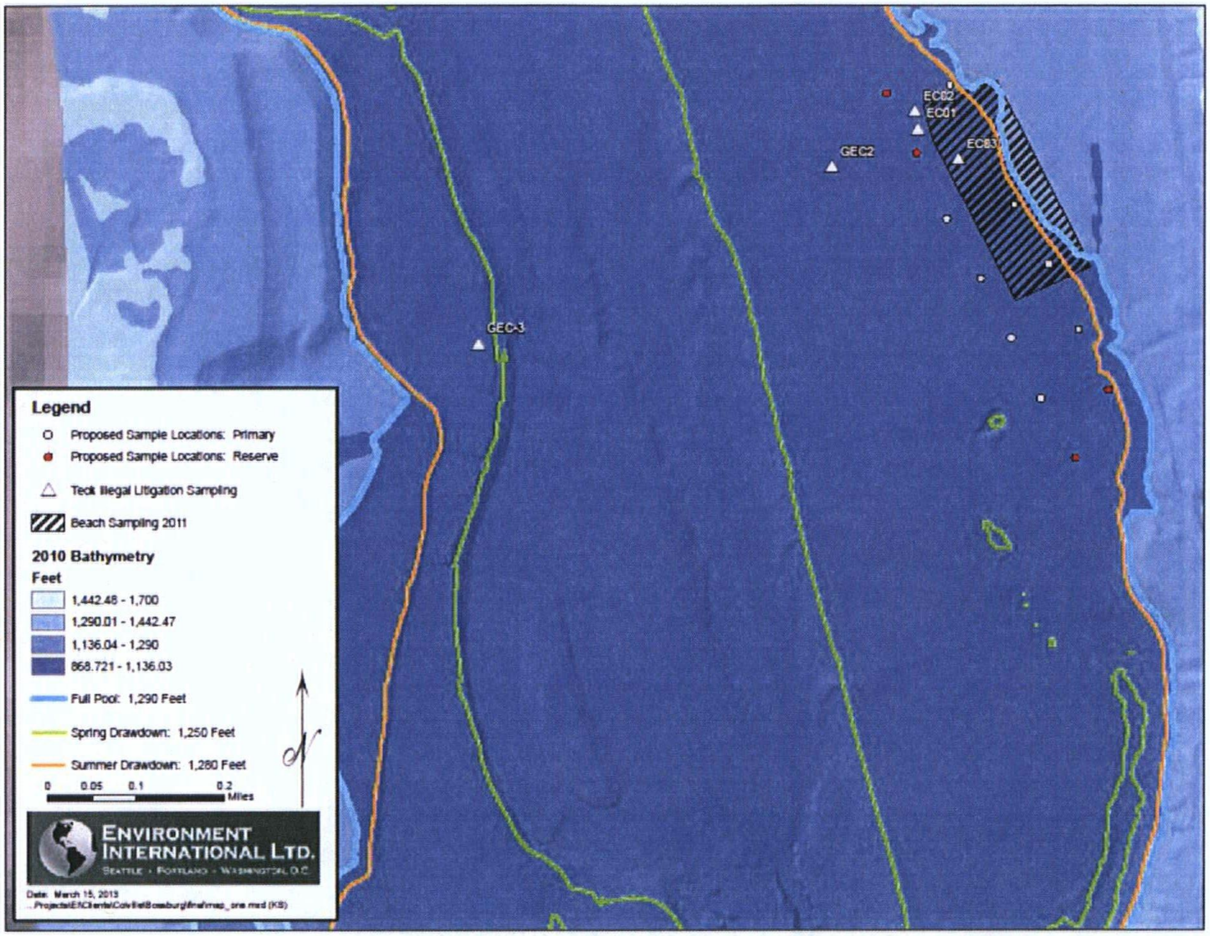
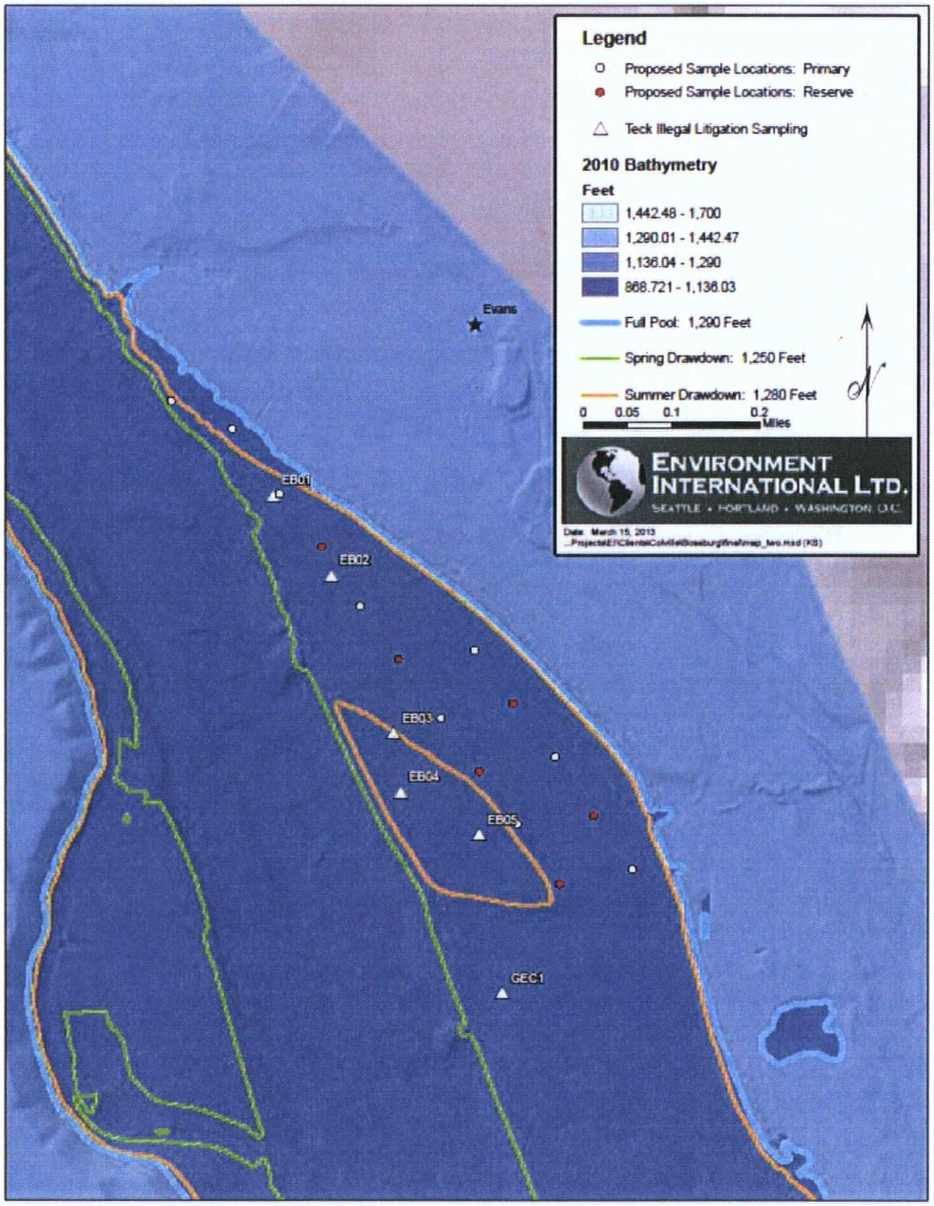

EC02
EC01
EC03
GEC2
GEC-3
Legend
Proposed Sample Locations: Primary
Proposed Sample Locations: Reserve
Teck Illegal Litigation Sampling
Beach Sampling 2011
2010 Bathymetry
Feet
1,442.48 - 1,700
1,290.01 - 1,442.47
1,136.04 - 1,290
868.721 - 1,136.03
Full Pool: 1,290 Feet
Spring Drawdown: 1,250 Feet
Summer Drawdown: 1,280 Feet
0 0.05 0.1 0.2
Miles
ENVIRONMENT INTERNATIONAL LTD.
Date: March 15, 2013

Figure 1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Proposed Sample Locations: Primary
Proposed Sample Locations: Reserve
Teck Illegal Litigation Sampling
2010 Bathymetry
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1,136.04 - 1,290
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Full Pool: 1,290 Feet
Spring Drawdown: 1,250 Feet
Summer Drawdown: 1,280 Feet
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SEATTLE • PORTLAND • WASHINGTON D.C.
Date: March 15, 2013
Evans
EB01
EB02
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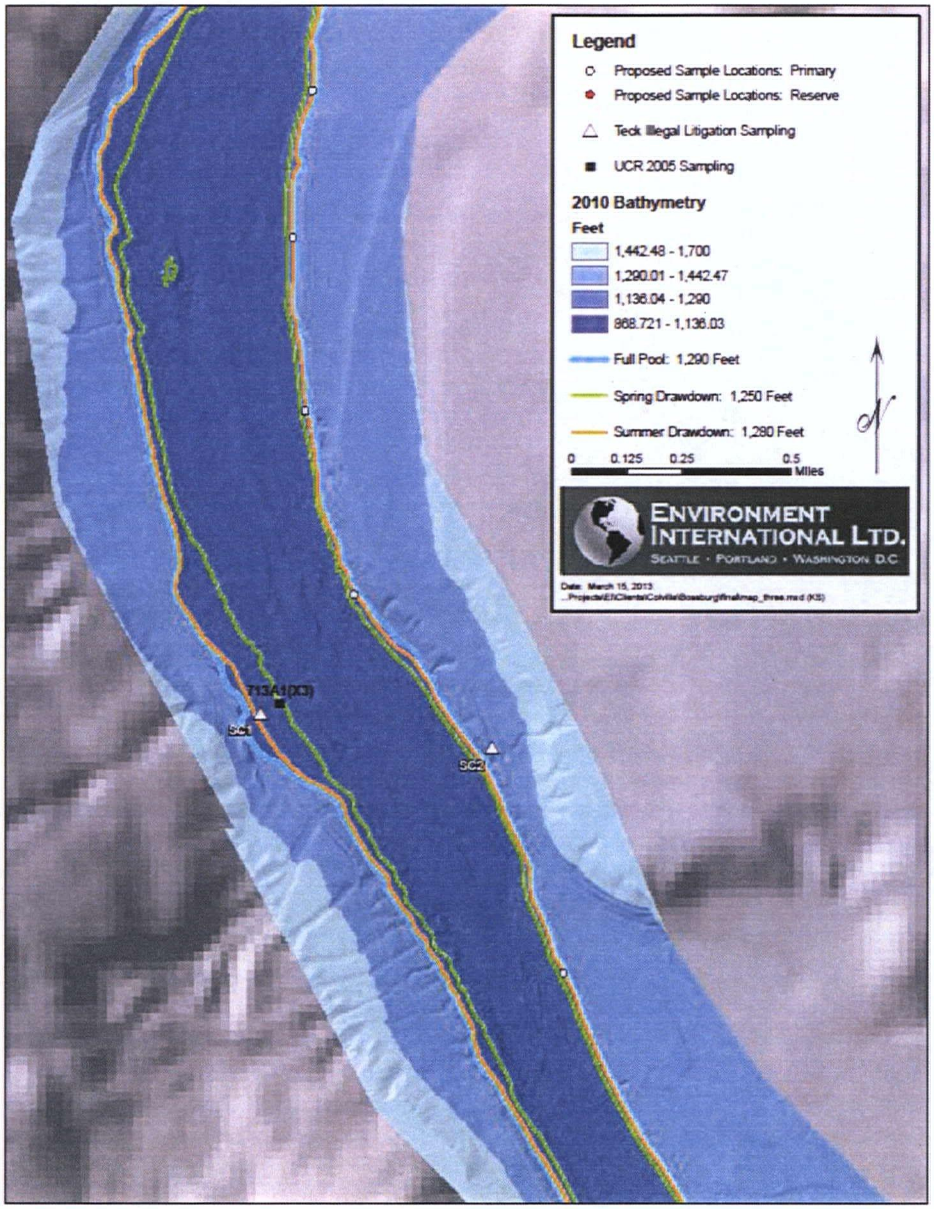
Figure 2


Legend
Proposed Sample Locations: Primary
Proposed Sample Locations: Reserve
Teck Illegal Litigation Sampling
UCR 2005 Sampling
2010 Bathymetry
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1,290.01 - 1,442.47
1,136.04 - 1,290
868.721 - 1,136.03
Full Pool: 1,290 Feet
Spring Drawdown: 1,250 Feet
Summer Drawdown: 1,280 Feet
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SEATTLE • PORTLAND • WASHINGTON D.C.
Date: March 15, 2013
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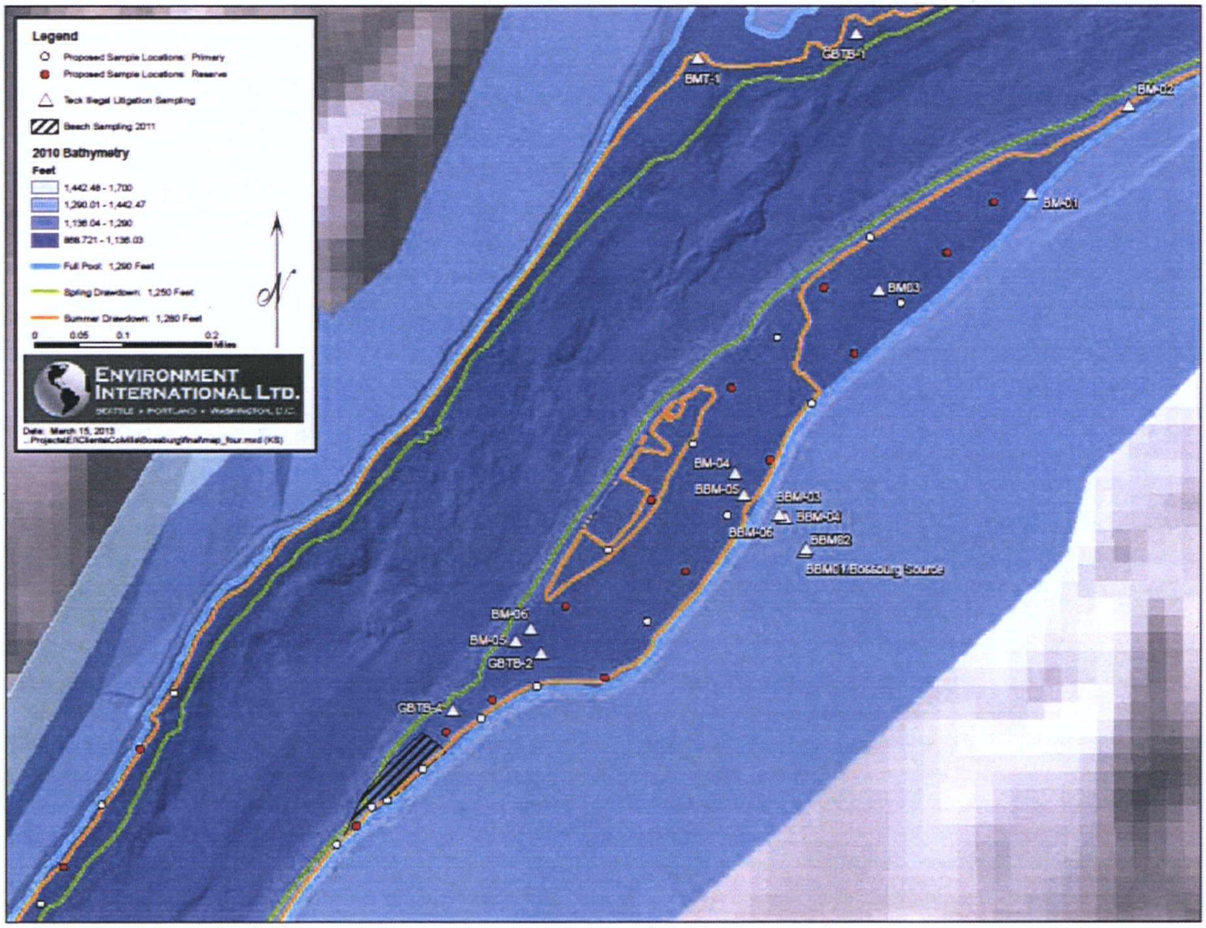
Figure 3



Legend
Proposed Sample Locations: Primary
Proposed Sample Locations: Reserve
Teck Illegal Litigation Sampling
Beach Sampling 2011
2010 Bathymetry
Feet
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1,290.01 - 1,442.47
1,136.04 - 1,290
868.721 - 1,136.03
Full Pool: 1,290 Feet
Spring Drawdown: 1,250 Feet
Summer Drawdown: 1,280 Feet
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Date: March 15, 2013
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BM-02
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BM-04
BBM-05
BBM-03
BBM-04
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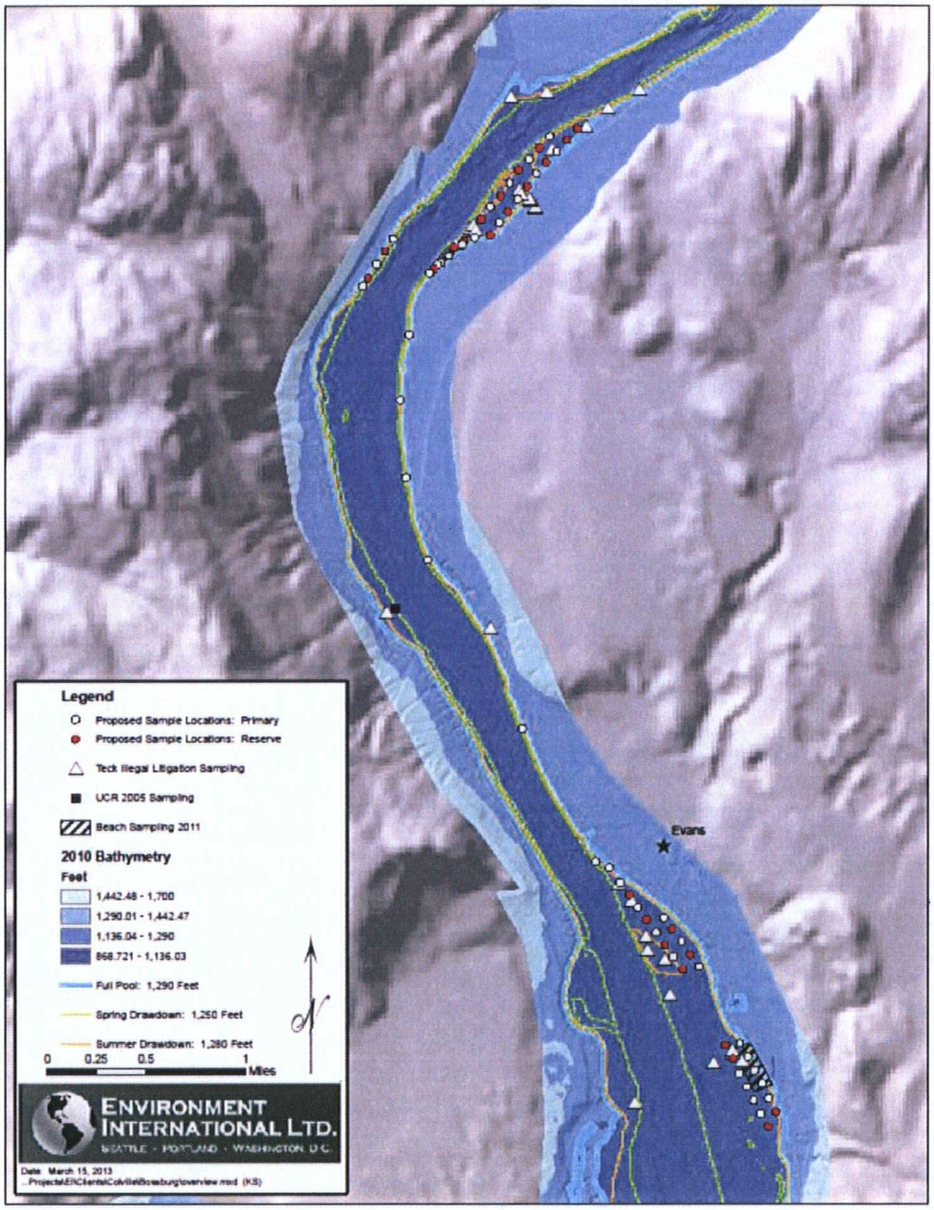
BBM02
BBM01/Bossburg Source
BM-06
BM-05
GBTB-2
GBTB-A

Figure 4


Evans
Legend
Proposed Sample Locations: Primary
Proposed Sample Locations: Reserve
Teck Illegal Litigation Sampling
UCR 2005 Sampling
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Spring Drawdown: 1,250 Feet
Summer Drawdown: 1,280 Feet
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Miles
ENVIRONMENT INTERNATIONAL LTD.
SEATTLE - PORTLAND - WASHINGTON, D.C.
Date: March 15, 2013

Figure 5

The purpose of this memorandum is to summarize the Data Quality Objectives (DQOs) for the UCR Bossburg Flats Beach Refined Sediment Study.

Data Quality Objectives (DQOs) define the type, quality, quantity, purpose, and intended uses of data to be collected (EPA, 2006a). In brief, the DQO process typically follows a seven-step procedure, as follows:

1. State the problem
2. Identify the goal of the study
3. Identify information inputs
4. Define the boundaries (in space and time) of the study
5. Develop the analytic approach
6. Specify performance or acceptance criteria
7. Develop the detailed plan for obtaining data

The detailed sampling and analysis plan (SAP) required by Step 7 should be included in the refined study quality assurance project plan. This memorandum includes requirements for the SAP, including Figure 1, which provides a conceptual level design that is consistent with the expected level of effort for the study (EPA, 2012a).

Data Quality Objectives

Step 1 – State the Problem

Elevated concentrations of lead and other metals have been measured in sediment and soil between the Young America Mine and Mill site and Evans Campground Beach, compared to other sampled beaches in the area. The objective of the Bossburg Flats Beach Refined Sediment Study is to collect data required to refine the aerial extent of contamination associated with the Bossburg Flats and Evans beaches above a level of concern for human health and to determine if contamination at the Young America Mill or the Historic Bossburg Town Site may be a source of contamination found at Bossburg Flats Beach.

Site Conceptual Model

Sources of Contamination

Sources of sediment contamination to the UCR site include the Teck Metals facility and formerly operating mines, mills and smelters that operated along the UCR and its tributaries (EPA, 2003; TAI, 2009; Appendix C). The Young America Mill site is located on a bench on the east bank of the UCR, on the west side of State Highway 25, approximately 4.2 miles north of Evans (EPA, 2012a). A Removal Assessment conducted by EPA found lead, arsenic and other metals at concentrations that pose a potential risk to human health (TechLaw, 2012a). An EPA removal action in November 2012 included removing old mill buildings and placing protective caps over the consolidated mill tailings impoundment and mill workings (EPA, 2012a). Overflow from the tailings impoundment historically discharged to the UCR (NPS, 2011).

The Bossburg Flats area is located adjacent the historic Bossburg town site, approximately a quarter mile south of the Young America Mill site (TechLaw, 2012b). The EPA UCR Remedial Investigation found metals contamination along the beach that poses risks to human health. An EPA Removal Assessment at Bossburg Flats also found lead and arsenic at concentrations that pose a potential risk to human health (TechLaw, 2012b). Concentrations of lead, zinc and other metals at the Young America Mill site and Bossburg Flats Beach also exceed ecological risk screening values (Ecological Risk, 2012).

A cable ferry crossing was in operation at Bossburg from approximately 1898 to 1940. Elevated Pb readings by field-portable XRF were recorded near remnants of ferry dock at Bossburg Flats (NPS, 2011; TechLaw, 2012b)

Fate and transport Mechanisms. General transport mechanisms for the movement of lead and other metals in the UCR are described in the Phase I Sediment Sampling Data Evaluation (CH2M Hill, 2006) and the DQOs for the 2011 beach sediment sampling QAPP (TAI, 2009, Appendix C). Transport mechanisms of primary concern for the subject QAPP include: the potential transport of lead and other metals from the upland areas at the Young America Mill site to the UCR, the potential transport of lead and other metals from the Bossburg Flats historic ferry dock area and Bossburg Flats upland to the adjacent and downstream shoreline and near-shore UCR by erosion of the soil and sediment via wave action, river current, surface runoff and wind.

Human Populations of Potential Concern. Potentially exposed populations include people who may come into contact with contaminated sediment while engaging in:

- subsistence hunting, fishing, and gathering activities;
- recreational activities including boating, camping, fishing, swimming and wading;
- occupational activities.

Young children (six and younger) are most at risk from exposure to lead. Inadvertent ingestion, driven by dermal adherence, is the primary exposure pathway of concern. Therefore, data on the concentration of metals in sediment particles less than 250 micrometers are needed to assess the risk to human health.

Problem statement

Lead was found at concentrations above preliminary human health risk screening levels in sediment samples collected in 2011 from Bossburg Flats Beach and Evan's Campground Beach (SRC, 2012).

Lead concentrations up to approximately 5,600 mg/kg and 3,500 were measured within and outside, respectively, of the former tailing impoundment at the Young America Mill site using a field-portable XRF (TeckLaw, 2012a). Laboratory results (SW846 3050B/6010B) confirmed the presence of lead and other metals in soil at the mill site above human health risk screening levels (TeckLaw, 2012a). To date, removal actions include the placement of protective caps on the former tailings impoundment area and associated mill wastes (EPA, 2012b).

Lead concentrations up to approximately 3,300 mg/kg were measured by field-portable XRF on the upland area of Bossburg Flat, and up to approximately 24,000 on Bossburg Flat Beach; arsenic was measured at up to approximately 300 mg/kg (TeckLaw, 2012b).

Bossburg Flats Beach and Evans Campground Beach are approximately 3 river miles apart and located downriver/downslope from the Young America Mill site, the Bossburg historic town site, the ferry crossing remnants at Bossburg Flat and the landing on the west side of the UCR, opposite Bossburg Flat.

Additional data are required to determine:

- If near shore sediment between the Young America Mill site and Evans Campground Beach are contaminated with lead or other metals at concentrations that pose a potential risk to human health. For example, the nature and extent of unacceptable lead risk from exposure to sediment at lead concentrations equal to or greater than 400 mg/kg has not been determined;
- If the Young America Mill site or the facilities associated with the former ferry crossing are likely sources of the elevated lead concentrations measured at Bossburg Flats Beach and Evan's Campground Beach;
- If the areas adjacent to the Young America Mill site, the ferry crossing sites, Bossburg Flats Beach or Evan's Campground Beach and are contaminated with lead or other metals at concentrations that pose a potential risk to human health via residential, recreational, or occupational exposure scenarios;
- Determine the horizontal and vertical extent of metals contamination at the ferry landing sites on the west and east banks of the UCR at Bossburg Flats;
- The bioavailability of lead and arsenic in sediment to improve the accuracy of lead risk predicted by the IEUBK model. Currently only in-vitro bioavailability for lead is used by EPA, but this may include arsenic in the future. An in-vitro bioavailability analysis for lead and arsenic should be performed on at least one ICS composite sample collected from each of the following locations/decision units (DUs):
    - Shoreline sediments downslope from the Young America Mill site (DU1 or DU2; the DU with highest lead concentration);
    - Bossburg Flats Beach (DU4);
    - Evans Campground Beach or south of Evans Campground Beach (DU7 or DU8: the DU with highest lead concentration);
    - Shoreline sediments between Bossburg and Evans (DU5 or DU12; the DU with highest lead concentration);
    - In-vitro bioavailability is not needed for samples with lead concentrations below 100 mg/kg
- To support source apportionment, the ratios of metals in the sediment should be determined (e.g., zinc/lead, manganese/lead). Visual observation of the sediment should also be recorded and reported in the Bossburg Beach Refined Sediment Study data summary report.

Step 2: Identify the Goals of the Study

The goal of the study is to collect near-shore and shoreline sediment data that will support reliable characterization of risks to humans who may be exposed to the sediments that are most likely to be above the water level during the summer (greater than or equal to1280-ft AMSL). The risk characterization will be used by risk managers to help determine whether or not EPA must take action at one or more locations to ensure that risks to humans who may be exposed to beach sediments along the UCR do not exceed an acceptable level.

Principal human health risk study question: Is lead, arsenic or other metals present in the <250 μm grain size fraction of sediment in the15cm depth interval at concentrations that pose a potential risk to human health, particularly during the summer months?

Step 3: Identify inputs to the decision

Existing data on metals concentration will be used provided the samples were collected from the 0-15 cm depth interval using incremental composite sampling methods, and represent the <250 μm grain size fraction. The Teck 2009-2010 remedial investigation sediment sampling efforts provide data that meet these criteria for Bossburg Flats Beach, Evans Campground Beach and Summer Island Beach.

Existing data will be supplemented with data from this study, including:

- Data collected from the 0-15 cm depth interval using incremental composite sampling methods, and sieved to <250 μm. This data will be used to estimate human health risk.
- Data from sediment cores (grab samples) samples collected at the former ferry crossing landings. This data will be used to assess the vertical extent of contamination.

Water elevations in the UCR are available on an hourly basis (NOAA, 2013).

Step 4: Define the study boundaries

River Mile: This study will focus on the section of the UCR between river miles 709 to 716.

Depth: Samples should be collected from the 0-15 cm depth interval as these are the most likely and frequent source of human contact with sediments.

Elevation: For the purposes of this planning effort, focus is placed on characterization of sediments located at and above 1280-ft above mean sea level at Bossburg Flats and Evans beach, previously identified as priority recreational use areas, because these sediments are typically accessible during the summer months and therefore are the most likely and frequent source of human contact with sediments. For source assessment and contaminant extent purposes, near-shore sediments include elevations above (greater than) 1250-ft above mean sea level.

Target population: The target population for this study consists of the surface (0-15 cm depth) near shore sediment located between river miles 709 and 716, and with surface elevation above 1250-ft above mean sea level. A subpopulation of primary importance is the established recreational beaches defined as the portion of the sediment with surface elevation between 1280-1290-ft above mean sea level. For decision units F-1 and F-2, located at the former ferry crossing landings, the target population cannot be defined with certainty at this time. The target population will be determined during field reconnaissance and at the time of sample collection, in consultation and direction by EPA.

Sampling Unit: Sampling units consist of incremental composite samples that include at least 30 increments. Details will be determined during the development of the QAPP. Step 7 describes requirements for sampling methods. In addition to the incremental composite samples, sediment core samples may be collected at the former ferry landing sites located at Bossburg Flats Beach.

Decision Unit: The scale of decision-making is the DU. Figure 1 shows a conceptual-level design of the location of the DUs for this study and Table 1 provides the rationale for each DU.

Step 5: Develop a decision rule for each Decision Unit

If the mean concentration of contaminant equals or exceeds its risk-based concentration (SRC, 2012) RBC (e.g., lead RBC = 400 mg/kg and arsenic RBC = 16 mg/kg), then retain the DU for additional risk evaluation in HHRA. For lead and arsenic, the RBA-adjusted concentrations are compared to the RBCs.

Step 6: Specify limits on decision errors

Statistical Hypothesis. The baseline condition (or null hypothesis, H_0) assumes the sediments are contaminated, and the baseline condition will be retained unless data support rejecting it (EPA 2006a).

For the purposes of the Bossburg Flat Beach Refined Sediment Study, the statistical hypotheses are defined as:

- **H_0** – the true mean concentration of the RBA-adjusted chemical in the <250 μm fraction of the 0-15 cm depth interval is greater than or equal to the RBC
- **H_a** – the true mean concentration of the RBA-adjusted chemical in the <250 μm fraction of the 0-15 cm depth interval is less than the RBC.

Tolerable limits on Decision Errors. Given the above null hypothesis, two types of decision errors are possible:

- A **false negative** decision error would occur if a risk manager decides that exposure to sediments is not of significant health concern, when it is.
- A **false positive** decision error would occur if a risk manager decides that exposure to sediments is above a level of concern, when it is not.

EPA wishes to minimize false negative decision errors, since an error of this type may leave humans exposed to unacceptable levels of contaminants in beach sediments. For this reason, the probability of a false negative decision error should be no more than 5%. This corresponds to comparing the 95% upper confidence limit (UCL) of the mean contaminant concentration to the sediment RBC. When the data lead to a rejection of the null, the use of the 95UCL provides a high confidence in the conclusion that the site does not pose an unacceptable level of risk to human health; i.e., there is no more than a 5% probability that the true mean is above the RBC.

EPA is also concerned with the probability of making false positive decision errors. Although this type of decision error does not result in unacceptable human exposure, it may result in unnecessary expenditure of resources. For the purposes of this effort, the goal is to control the false positive decision error rate at 20%. For lead, the false positive decision error rate corresponds to the ability to detect a true mean that is ≤ 250 mg/kg; i.e., when the true mean lead concentration is ≤ 250 mg/kg, the probability that the 95UCL will equal or exceed the RBC is no more than 20%. This goal can be achieved by adjusting the number of ICS samples or increments.

Step 7: Develop the plan for obtaining data

The study should use incremental sampling which offers the following advantages for this study:

- Maximize the mass of the sampled material and the areal extent of field sampling; i.e., increases the sample support;
- Produce representative and reproducible (high precision) estimates of the mean concentration of lead and other metals within each DU;
- Control processing and analytical laboratory errors

Each incremental sample should consist of at least 30 increments. The increments for each sample should be collected using a systematic grid to achieve good spatial coverage (Interstate Technology & Regulatory Council 2012).

At a minimum, at least one incremental composite sample should be collected from DUs 1-10; the approximate locations of the DUs are shown in Figure 1 and the rationale for each DU is provided in Table 1. Sample locations are contingent upon the presence of fine sediment material (i.e., sand and smaller particle sizes). As plotted on Figure 1, eight DUs will encompass elevations between 1250 ft. and 1290 ft. Two DUs (Bossburg Flat and Evans Campground Beaches) will be located between 1280 ft. to 1290 ft. The approach for core stations F1 and F2 are yet defined, pending a field reconnaissance. Triplicate incremental composite samples should be collected from DU #2, 3, 6 and 9 to facilitate estimating upper confidence limits (UCLs) for the incremental sample means. **Each of the triplicate incremental samples should be collected such that it represents the entire DU.** Upper confidence limits for DUs that do not have triplicate samples may be calculated by using the highest standard deviation available from the four DUs (DU's 2, 4, 7 and 11), for that particular metal. Optionally, additional triplicates may be collected.

A minimum of three core samples should be collected from each of the former ferry crossing landings areas, indicated as F-1 and F-2 in Figure 1. The location and depth of the cores will be determined during field reconnaissance and at the time of sample collection, in consultation and direction by EPA.

Preliminary sample design calculations with Visual Sample Plan (PNNL, 2010) indicated three incremental composite samples each consisting of 30 increments could achieve the goals for decision error rates specified in Step 6 (Figure 2).

Increments should be collected with a coring device (not spoons or scoops) similar to the ones described in (USACE, 2004.)

The QAPP should specify that samples should not be processed in the field. The QAPP should include sample processing standard operating procedures that provide detailed procedures to ensure analytical subsamples are representative of samples collected in the field, are appropriate for incremental sampling methods, and consistent with the methods described in (Gerlach and Nocerino, 2003; Petersen, et al., 2005; US EPA, 2006b and ALS, 2011). At a minimum, the SOPs shall address the following:

- Sample homogenization
- Splitting and mass reduction
- Drying and sieving
- Representative subsampling

REFERENCES

ALS Environmental. 2011. Incremental Sampling Methodology. June 22. Accessed on March 28, 2013. http://www.caslab.com/News/incremental-sampling-methodology.html

CH2M Hill. 2006. Phase I Sediment Data Evaluation – Upper Columbia River Site, CERCLA RI/FS. Prepared for U.S. Environmental Protection Agency, Region 10, Seattle, WA. August 25, 2006.

Ecological Risk Inc. 2012. Screening evaluation of XRF soil observations at the Young America Mine and Bossburg Flats, Washington. July 3. Technical Memorandum prepared for EPA.

Gerlach, R. W. and R. Nocerino. 2003. United States Environmental Protection Agency. Office of Research and Development. National Exposure Research Laboratory . Environmental Sciences (2004). Guidance for obtaining representative laboratory analytical subsamples from particulate laboratory samples. Washington, DC, U.S. Environmental Protection Agency, Office of Research and Development, National Exposure Research Laboratory, Environmental Sciences Division. http://www.epa.gov/nerlesd1/cmb/pdf/guidance.pdf

Interstate Technology & Regulatory Council (2012). Technical and Regulatory Guidance: Incremental Sampling Methodology, ITRC: 475 pp. http://www.itrcweb.org/gd.asp

Petersen, L., P. Minkkinen and K. H. Esbensen (2005). "Representative sampling for reliable data analysis: Theory of Sampling." Chemometrics and Intelligent Laboratory Systems **77**(1-2): 261-277. http://www.sciencedirect.com/science/article/pii/S0169743904002448

SRC, Inc. 2012. UCR HHRA 2011 Beach Sediment Screen. Memorandum prepared for EPA. February 15.

Teck American Incorporated (TAI). 2009. Upper Columbia River 2009 Quality Assurance Project Plan for the Beach Sediment Study. Integral Consulting, Inc., Parametrix and Hydroqual, Inc. and Archaeological Investigations Northwest, Inc. for TAI.

TechLaw. 2012a. Young America Mine removal assessment trip report. Evans, Stevens County, Washington. Prepared for EPA Region 10, EPA Contract Number EP-S7-06-03. Seattle, WA.

TechLaw. 2012b. Bossburg Flat removal assessment trip report. Evans, Stevens County, Washington. Prepared for EPA Region 10, EPA. Contract Number EP-S7-06-03. Seattle, WA.

U.S. Army Corps of Engineers (USACE). 2004. Field Sampling Tools for Explosives Residues Developed at CRREL. Engineering Research and Development Center. Cold Regions Research and Engineering Laboratory. ERDC/CRREL TN-04-1. April. Available online: http://www.crrel.usace.army.mil/library/technicalnotes/TN04-1.pdf

U.S. Department of Interior, National Park Service. (NPS). 2011. Electronic mail from Ray DePuydt, NPS to Monica Tonel, EPA, Re: Some History of Bossburg, prepared by Jim Retzer, NPS.

U.S. Environmental Protection Agency (USEPA). 2003. Upper Columbia River Expanded Site Inspection Report; Northeast Washington. TDD:01-02-0028. Contract: 68-S0-01-01. U.S. Environmental Protection Agency, Region 10, Seattle, WA. 84 pp.

U.S. Environmental Protection Agency (USEPA) 2006a. Guidance on Systematic Planning Using the Data Quality Objectives Process – EPA QA/G4. Office of Environmental Information, U.S. Environmental Protection Agency. EPA/240/B-06/001. February. http://www.epa.gov/quality/qs-docs/g4-final.pdf

U.S. Environmental Protection Agency (USEPA) 2006b. Method 8330B Revision 2: Nitroaromatics, nitramines, and nitrate esters by High Performance Liquid Chromatography (HPLC); Appendix A - collecting and processing of representative samples for energetic residues in solid matrices from military training ranges. Washington, D.C., Office of Solid Waste: 60. http://www.epa.gov/osw/hazard/testmethods/pdfs/8330b.pdf

U.S. Environmental Protection Agency (USEPA). 2012a. Letter from R. Matthew Wilkening, EPA to Marko Adzic, Teck American Incorporated, Re: LOW to Sample Bossburg Flats Area and Young America Mill Site. November.

U.S. Environmental Protection Agency (USEPA). 2012b. Pollution/Situation Report. Subject: Initial and Final Removal POLREP, Hahnlen Property 10KN, Evans, WA. November 3.

U.S. National Oceanic and Atmospheric Administration (NOAA). 2013. National Weather Service. Advanced Hydrologic Prediction Service. Columbia River above Grand Coulee Dam. http://water.weather.gov/ahps2/hydrograph.php?wfo=otx&gage=gcdw1

VSP Development Team. 2013. Visual Sample Plan: A Tool for Design and Analysis of Environmental Sampling. Version 6.3. Pacific Northwest National Laboratory. Richland, WA. http://vsp.pnnl.gov

Table 1. The rationale for the location of the proposed decision units (DUs). The overall objective is to delineate the nature and extent of human health risk/contamination.		
Decision Unit (DU)	Elevation range (ft)	Location Rationale
1	1250-1290	Located upstream of the former tailings pond effluent culvert.
2	1250-1290	Located downstream of the former tailings pond effluent culvert.
3	1280-1290	Characterize human health risk from exposure to sediment that is most frequently above water level during the summer (June-August).
4	1250-1290	Downstream of area where elevated concentrations of metals have been measured.
5	1250-1290	Upstream of area where elevated concentrations of lead and arsenic have been measured.
6	1280-1290	Characterize human health risk from exposure to sediment that is most frequently above water level during the summer (June-August).
7	1250-1290	Downstream of area where elevated concentrations of lead and arsenic have been measured.
8	1250-1290	Located cross-river and upstream of the former tailings pond effluent culvert,
9	1250-1290	Located on the west bank of the former ferry landing
10	1250-1290	Located downstream of former ferry landing, and cross-river and downstream of area where elevated concentrations of metals have been measured.

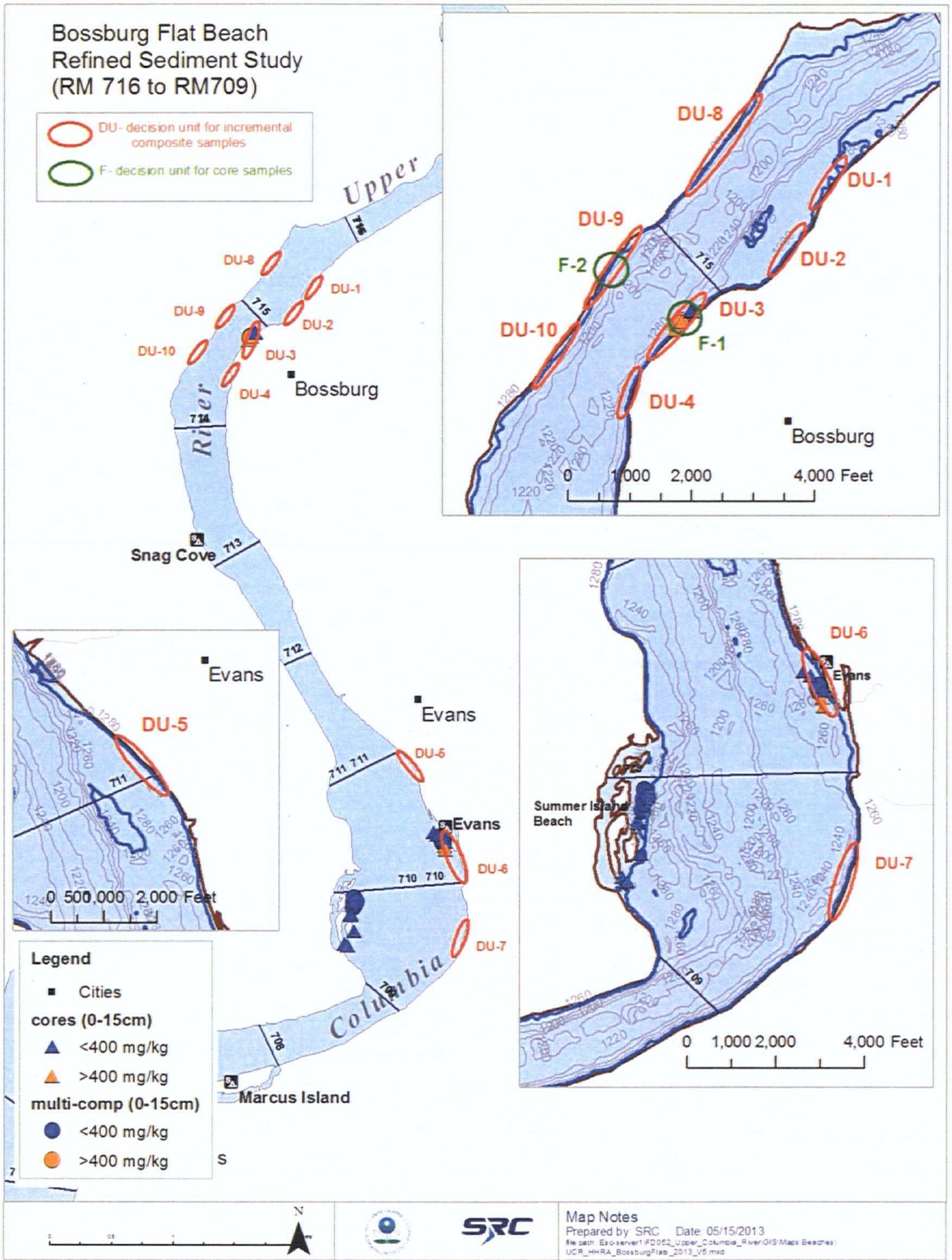

Figure 1. DRAFT - Conceptual layout of the Decision Units (DUs). The 1280-ft and 1290-ft water elevation levels are indicated in royal blue and brown, respectively.

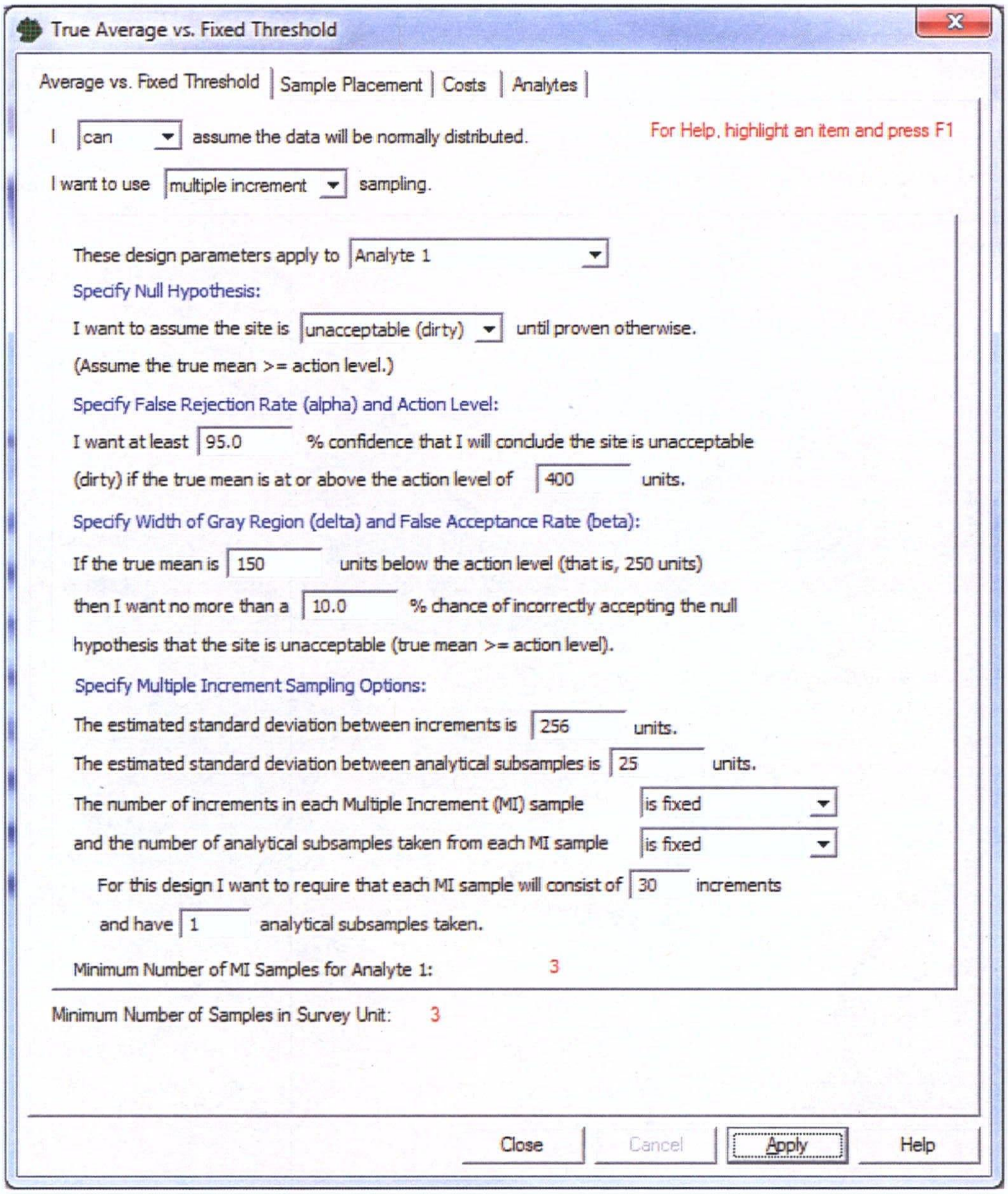

Figure 2. Screen capture from Visual Sampling Plan, Version 6.3 (VSP Development Team, 2013), indicating 3 ICS samples are sufficient to determine if the mean concentration exceeds 400 mg/kg. The null hypothesis is the lead concentration in the <250µm grain size fraction exceeds 400 mg/kg.

UCR Bossburg Soil Study

The purpose of this memorandum is to summarize the Data Quality Objectives (DQOs) for the UCR Bossburg Soil Study.

Data Quality Objectives (DQOs) define the type, quality, quantity, purpose, and intended uses of data to be collected (U.S. EPA 2006). In brief, the DQO process typically follows a seven-step procedure, as follows:

1. State the problem
2. Identify the goal of the study
3. Identify information inputs
4. Define the boundaries (in space and time) of the study
5. Develop the analytic approach
6. Specify performance or acceptance criteria
7. Develop the detailed plan for obtaining data

The detailed sampling and analysis plan (SAP) required by Step 7 should be included in the refined study quality assurance project plan. This memorandum includes requirements for the SAP, including Figure 1, which provides a conceptual level design that is consistent with the expected level of effort for the study (EPA, 2012a)

Data Quality Objectives

Step 1 – State the Problem

Elevated concentrations of lead and arsenic have been measured in soil near the historic town site of Bossburg located, adjacent and upslope, to the east, from the beach at Bossburg Flats. The objective of the Bossburg soil study is to delineate the extent of contamination above a level of concern for human health and to determine if contamination in soils is contributing to contamination found along the Columbia River, including the reach from Bossburg Flats to Evans Beach. If results indicate that a decision unit exceeds a risk based concentration, and is not bounded by adjacent DUs below a level of concern then additional "step out" sampling may be needed.

Site Conceptual Model

<u>Sources of Contamination</u>

Sources of contamination to the UCR site include the Teck Metals facility and formerly operating mines, mills, smelters, and associated infrastructure in the vicinity: including ferries, roads, and railroad depots (EPA, 2003; TAI, 2009; Appendix C). The Young America Mill site is located on a bench on the east bank of the UCR, on the west side of State Highway 25, approximately 4.2 miles north of Evans (EPA, 2012a). A Removal Assessment conducted by EPA found lead, arsenic and other metals at concentrations that pose a potential risk to human health (TechLaw, 2012a). An EPA removal action in

November 2012 included removing old mill buildings and placing a cap over the mill tailings impoundment (EPA, 2012a). Overflow from the tailings impoundment discharged to the UCR (NPS, 2011). The Bossburg Flats area is located approximately a quarter mile south of the Young America Mill site (TechLaw, 2012b). An EPA Removal Assessment at Bossburg Flats found lead and arsenic at concentrations that pose a potential risk to human health (TechLaw, 2012b). Concentrations of lead, zinc and other metals at the Young America Mill site and Bossburg Flats also exceed ecological risk screening values (Ecological Risk, 2012).

A cable ferry crossing was in operation at Bossburg from approximately 1898 to 1940. Elevated Pb readings by field-portable XRF were observed from remnants of ferry dock extending upslope including a small area of the plateau at Bossburg Flats (NPS, 2011; TechLaw, 2012b)

Fate and transport Mechanisms. General transport mechanisms for the movement of lead and other metals in the UCR are described in the Phase I Sediment Sampling Data Evaluation (CH2M Hill, 2006) and the DQOs for the 2011 beach sediment sampling QAPP (TAI, 2009, Appendix C). Transport mechanisms of primary concern include the transport of lead and other metals from the upland areas at the Young America Mill site and Bossburg Flats to the adjacent shoreline and UCR by erosion of the soil and sediment via surface runoff and wind, past tailings pond releases, and spills from ore and concentrate transport via ferry, road, or train.

Human Populations of Potential Concern. Potentially exposed populations include people who may contact contaminated soil while engaging in:

- subsistence hunting, fishing, and gathering activities;
- recreational activities including boating, camping, fishing, swimming and wading;
- occupational activities.

Young children (six and younger) are most at risk from exposure to lead. Inadvertent ingestion, driven by dermal adherence, is the primary exposure pathway of concern. Therefore, data on the concentration of metals in soil particles less than 150 micrometers (μm) are needed to assess the risk to human health (Ruby and Lowney 2012).

Problem statement

Lead was found at concentrations above preliminary human health risk screening levels in soil samples collected upslope from Bossburg Flats Beach (TeckLaw, 2012b).

Lead concentrations up to approximately 5,600 mg/kg and 3,500 were measured within and outside, respectively, of the former tailing impoundment at the Young America Mill site using a field-portable XRF (TeckLaw, 2012a). Laboratory results (SW846 3050B/6010B) confirmed the presence of lead and other metals in soil and sediment at the site above regional risk screening levels (TeckLaw, 2012a). Lead concentrations up to approximately 3,300 mg/kg were measured by field-portable XRF on the upland area of Bossburg Flat, and up to approximately 24,000 on Bossburg Flat beach; arsenic was measured at up to approximately 300 mg/kg (TeckLaw, 2012b). To date, removal actions have included placement of a cap on the former tailings impoundment area (EPA, 2012b).

Additional data are required to determine:

- If the soils adjacent to the Young America Mill site and tailing pond, the ferry crossing site, the historic Bossburg town site are contaminated with lead or other metals at concentrations that pose a potential risk to human health via residential, subsistence, occupational, or recreational exposure scenarios;
- The bioavailability of lead and arsenic in soil to improve the accuracy of lead risk predicted by the IEUBK model. An in-vitro bioavailability analysis for lead and arsenic should be performed on at least one ICS composite sample collected from each of the following locations. Currently only in-vitro bioavailability for lead is used by EPA, but this may include arsenic in the future:
    - In-vitro bioavailability is not needed for samples with lead concentrations below 100 mg/
    - Ratios of metals in the soil should be determined (e.g., zinc/lead, manganese/lead) to support source apportionment inferences. Visual observations of the soil should also be recorded and reported in the Bossburg Soil Study data summary report.

Step 2: Identify the Goals of the Study

The goal of the study is to collect soil data to support reliable characterization of risks to humans who may be exposed to the soils contaminated with lead, arsenic, and other metals from past mining activities and to delineate the limits of contamination above a risk level of concern. The risk characterization will be used by risk managers to help determine whether or not EPA must take action at one or more locations to ensure that risks to humans who may be exposed to beach soils along the UCR do not exceed an acceptable level.

Principal study questions: Is lead, arsenic or other metals present in the <150 µm grain size fraction of soil in the 0-15 cm depth interval at concentrations that pose a potential risk to human health?

Past transportation or milling practices may have resulted in the contamination at the site resulting in the burial of the contamination with time. Does soil at depths greater than 15 cm below the ground surface contain lead, arsenic, or other metals at concentrations that pose a potential risk to human health or the environment?

Step 3: Identify inputs to the decision

- Human health risk-based screening values (RBC) for lead (400 mg/kg) and arsenic (16 mg/kg)
- Data collected primarily from the 0-15cm depth interval using incremental composite sampling methods, and sieved to <150 µm. This data will be used to estimate human health risk.
- Data collected from the >15 cm depth interval from the core samples may be used to estimate human health risk as well.

Step 4: Define the study boundaries

This study will focus on likely areas of contamination based on previous data, including in-situ XRF measures, prior mining activities: including tailings pond discharges from the Young America mill and transportation of ore and concentrates via ferry, road, or rail.

Depth: Samples should be collected from the 0-15cm depth interval as these are the most likely and frequent source of human contact with soils.

__**Target population:**__ The target population for this study consists of the surface soil (0-15cm depth) less than 150 μm located in the historic town site of Bossburg, including the ferry landing on the opposite River bank, which served as a mining camp for the Young America Mine and a transportation center for other mines in the vicinity. Concentrates are believed to have moved through Bossburg via ferry, truck, and railroad.

Sampling Unit: Sampling units consist of incremental composite samples that include at least 30 increments. Details will be determined during the development of the QAPP. Step 7 describes requirements for sampling methods. In addition to the incremental composite samples, core samples will be collected to delineate the vertical extent of contamination. Decision Unit: The scale of decision-making is the decision unit (DU). Figure 1 shows a conceptual-level design of the location of six DUs for this study.

Step 5: Develop a decision rule for each Decision Unit

If the mean concentration of contaminant in the less than 150 μm soil fraction equals or exceeds its risk-based concentration (SRC, 2012) RBC (e.g., lead RBC = 400 mg/kg and arsenic RBC = 16 mg/kg), then retain the DU for additional risk evaluation in HHRA. For lead and arsenic, the RBA-adjusted concentrations are compared to the RBCs, using an in-vitro method for lead and an EPA default value of 0.6 for arsenic (U.S. Environmental Protection Agency 2012).

Given the uncertainty in estimating a mean with three core (grab) samples, the maximum concentration of each metal will be compared to its RBC. If the maximum concentration for lead, arsenic or other metal is observed at concentrations that exceed its RBC in the core samples collected from each DU, additional sampling will be required to delineate the vertical and horizontal extent of contamination.

Step 6: Specify limits on decision errors

Statistical Hypothesis. The baseline condition (or null hypothesis, H_0) assumes the soils are contaminated, and the baseline condition will be retained unless data support rejecting it (EPA 2006a).

For the purposes of the Bossburg Flat Beach Refined Soil Study for surface soil, the statistical hypotheses are defined as:

- $\mathbf{H_0}$ – the true mean concentration of the RBA-adjusted chemical in the <150 μm fraction of the 0-15 cm depth interval is greater than or equal to the RBC
- $\mathbf{H_a}$ – the true mean concentration of the RBA-adjusted chemical in the <150 μm fraction of the 0-15 cm depth interval is less than the RBC.

For the core samples the statistical hypotheses are defined as:

- $\mathbf{H_0}$ – the maximum concentration of the RBA-adjusted chemical in the <150 μm fraction of the >15 cm depth interval is greater than or equal to the RBC
- $\mathbf{H_a}$ – the maximum concentration of the RBA-adjusted chemical in the <150 μm fraction of the >15 cm depth interval is less than the RBC.

Tolerable limits on Decision Errors. Given the above null hypothesis, two types of decision errors are possible:

- A **false negative** decision error would occur if a risk manager decides that exposure to soils is not of significant health concern, when it is.
- A **false positive** decision error would occur if a risk manager decides that exposure to soils is above a level of concern, when it is not.

Incremental Composite Samples: EPA wishes to minimize false negative decision errors, to avoid leaving unacceptable levels of contaminants behind. For this reason, the probability of a false negative decision error should be no more than 5%. This corresponds to comparing the 95% upper confidence limit (UCL) of the mean contaminant concentration to the RBC. When the data lead to a rejection of the null, the use of the UCL95 provides a high confidence in the conclusion that the site does not pose an unacceptable level of risk to human health; i.e., there is no more than a 5% probability that the true mean is above the RBC.

EPA is also concerned with the probability of making false positive decision errors. Although this type of decision error does not result in unacceptable human exposure, it can waste resources which may not be available where needed. For the purposes of this effort, the goal is to control the false positive decision error rate at 20%. For lead, the false positive decision error rate corresponds to the ability to detect a true mean that is ≤ 250 mg/kg; i.e., when the true mean lead concentration is ≤ 250 mg/kg, the probability that the 95UCL will equal or exceed the RBC is no more than 20%. This goal can be achieved by adjusting the number of ICS samples or increments.

Step 7: Develop the plan for obtaining data

The study should use incremental sampling which offers the following advantages for this study:

- Maximize the mass of the sampled material and the areal extent of field sampling; i.e., increases the sample support;
- Produce representative and reproducible (high precision) estimates of the mean concentration of lead and other metals within each DU;
- Control processing and analytical laboratory errors

Each incremental sample should consist of at least 30 increments. The increments for each sample should be collected using a systematic grid to achieve good spatial coverage (Interstate Technology & Regulatory Council 2012).

At a minimum, at least one incremental composite sample should be collected from DUs 1-6; the approximate locations of the DUs are shown in Figures 1 and 2. Triplicate incremental composite samples should be collected from DU #4 to facilitate estimating upper confidence limits (UCLs). **Each of the triplicate incremental samples should be collected such that it represents the entire DU.** Upper confidence limits for DUs that do not have triplicate samples may be calculated by using the standard deviation from DU 4 or additional triplicates may be collected.

A minimum of three core samples should be collected from each DU. The location and depth of the cores will be determined during field reconnaissance and at the time of sample collection, in consultation and direction by EPA.

Preliminary sample design calculations with Visual Sample Plan (PNNL, 2010) indicated three incremental composite samples each consisting of 30 increments could achieve the goals for decision error rates specified in Step 6 (Figure 4).

Increments should be collected with a coring device (not spoons or scoops) similar to the ones described in (USACE, 2004.)

The QAPP should specify that incremental composite samples should not be processed in the field. The QAPP should include sample processing standard operating procedures that provide detailed procedures to ensure analytical subsamples are representative of samples collected in the field, are appropriate for incremental sampling methods, and consistent with the methods described in (Gerlach and Nocerino, 2003; Petersen, et al., 2005; US EPA, 2006b and ALS, 2011). At a minimum, the SOPs shall address the following:

- Sample homogenization
- Splitting and mass reduction
- Drying and sieving
- Representative subsampling

Decision Unit (DU)	Location Rationale
1	Northern boundary Bossburg Historic Town Site
2	Eastern boundary Bossburg Historic Town Site
3	Southern boundary Bossburg Historic Town Site
4	Western boundary Bossburg Historic Town Site – area of elevated lead XRF measures.
5	Culvert which drained the former tailings pond at Young America Mill.
6	West bank of historic cable ferry landing

REFERENCES

ALS Environmental. 2011. Incremental Sampling Methodology. June 22. Accessed on March 28, 2013. http://www.caslab.com/News/incremental-sampling-methodology.html

CH2M Hill. 2006. Phase I Sediment Data Evaluation – Upper Columbia River Site, CERCLA RI/FS. Prepared for U.S. Environmental Protection Agency, Region 10, Seattle, WA. August 25, 2006.

Ecological Risk Inc. 2012. Screening evaluation of XRF soil observations at the Young America Mine and Bossburg Flats, Washington. July 3. Technical Memorandum prepared for EPA.

Gerlach, R. W. and R. Nocerino. 2003. United States Environmental Protection Agency. Office of Research and Development. National Exposure Research Laboratory . Environmental Sciences (2004). Guidance for obtaining representative laboratory analytical subsamples from particulate laboratory samples. Washington, DC, U.S. Environmental Protection Agency, Office of Research and Development, National Exposure Research Laboratory, Environmental Sciences Division. http://www.epa.gov/nerlesd1/cmb/pdf/guidance.pdf

Interstate Technology & Regulatory Council (2012). Technical and Regulatory Guidance: Incremental Sampling Methodology, ITRC: 475 pp. http://www.itrcweb.org/gd.asp

Petersen, L., P. Minkkinen and K. H. Esbensen (2005). "Representative sampling for reliable data analysis: Theory of Sampling." Chemometrics and Intelligent Laboratory Systems **77**(1-2): 261-277. http://www.sciencedirect.com/science/article/pii/S0169743904002448

Ruby, M. V. and Y. W. Lowney (2012). "Selective soil particle adherence to hands: implications for understanding oral exposure to soil contaminants." Environ Sci Technol 46(23): 12759-12771. http://www.ncbi.nlm.nih.gov/pubmed/23148503

SRC, Inc. 2012. UCR HHRA 2011 Beach Sediment Screen. Memorandum prepared for EPA. February 15.

Teck American Incorporated (TAI). 2009. Upper Columbia River 2009 Quality Assurance Project Plan for the Beach Sediment Study. Integral Consulting, Inc., Parametrix and Hydroqual, Inc. and Archaeological Investigations Northwest, Inc. for TAI.

TechLaw. 2012a. Young America Mine removal assessment trip report. Evans, Stevens County, Washington. Prepared for EPA Region 10, EPA Contract Number EP-S7-06-03. Seattle, WA.

TechLaw. 2012b. Bossburg Flat removal assessment trip report. Evans, Stevens County, Washington. Prepared for EPA Region 10, EPA. Contract Number EP-S7-06-03. Seattle, WA.

U.S. Army Corps of Engineers (USACE). 2004. Field Sampling Tools for Explosives Residues Developed at CRREL. Engineering Research and Development Center. Cold Regions Research and Engineering Laboratory. ERDC/CRREL TN-04-1. April. Available online: http://www.crrel.usace.army.mil/library/technicalnotes/TN04-1.pdf

U.S. Department of Interior, National Park Service. (NPS). 2011. Electronic mail from Ray DePuydt, NPS to Monica Tonel, EPA, Re: Some History of Bossburg, prepared by Jim Retzer, NPS.

U.S. Environmental Protection Agency (USEPA). 2003. Upper Columbia River Expanded Site Inspection Report; Northeast Washington. TDD:01-02-0028. Contract: 68-S0-01-01. U.S. Environmental Protection Agency, Region 10, Seattle, WA. 84 pp.

U.S. Environmental Protection Agency (USEPA) 2006a. Guidance on Systematic Planning Using the Data Quality Objectives Process – EPA QA/G4. Office of Environmental Information, U.S. Environmental Protection Agency. EPA/240/B-06/001. February. http://www.epa.gov/quality/qs-docs/g4-final.pdf

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U.S. Environmental Protection Agency (USEPA). 2012a. Letter from R. Matthew Wilkening, EPA to Marko Adzic, Teck American Incorporated, Re: LOW to Sample Bossburg Flats Area and Young America Mill Site. November.

U.S. Environmental Protection Agency (USEPA). 2012b. Pollution/Situation Report. Subject: Initial and Final Removal POLREP, Hahnlen Property 10KN, Evans, WA. November 3.

U.S. National Oceanic and Atmospheric Administration (NOAA). 2013. National Weather Service. Advanced Hydrologic Prediction Service. Columbia River above Grand Coulee Dam. http://water.weather.gov/ahps2/hydrograph.php?wfo=otx&gage=gcdw1

VSP Development Team. 2013. Visual Sample Plan: A Tool for Design and Analysis of Environmental Sampling. Version 6.3. Pacific Northwest National Laboratory. Richland, WA. http://vsp.pnnl.gov

References Cited

Interstate Technology & Regulatory Council (2012). Technical and Regulatory Guidance: Incremental Sampling Methodology, ITRC: 475 pp. http://www.itrcweb.org/gd.asp

U.S. Environmental Protection Agency (2012). Recommendations for Default Value for Relative Bioavailability of Arsenic in Soil. Washington, DC, Office of Solid Waste and Emergency Response: 4 p. http://www.epa.gov/superfund/bioavailability/pdfs/Arsenic%20Bioavailability%20POLICY%20Memorandum%2012-20-12.pdf

U.S. EPA (2006). Guidance on systematic planning using the data quality objectives process (EPA QA/G-4). Washington, D.C.: 121. http://www.epa.gov/quality/qs-docs/g4-final.pdf

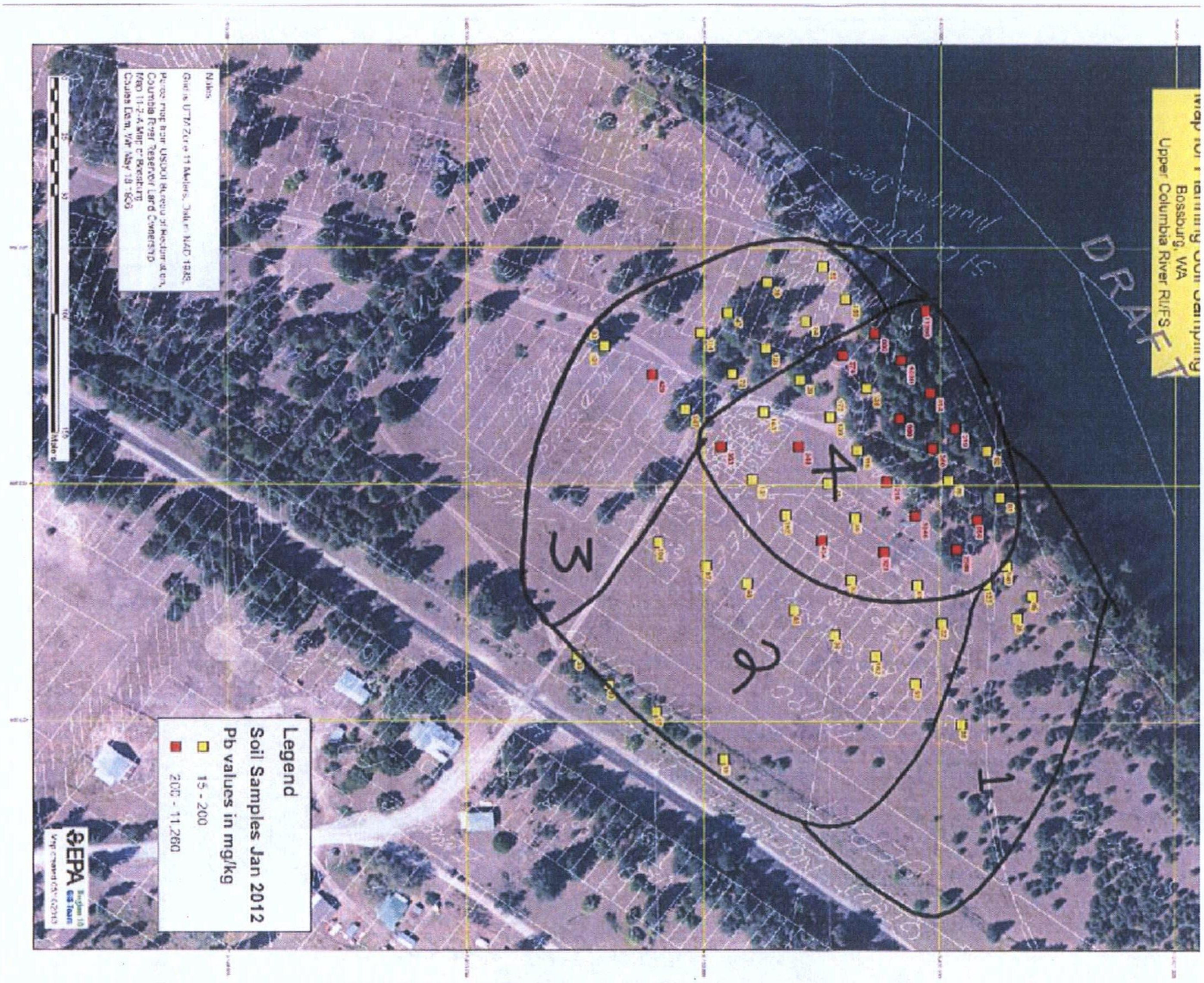

Figure 1. Bossburg Townsite.

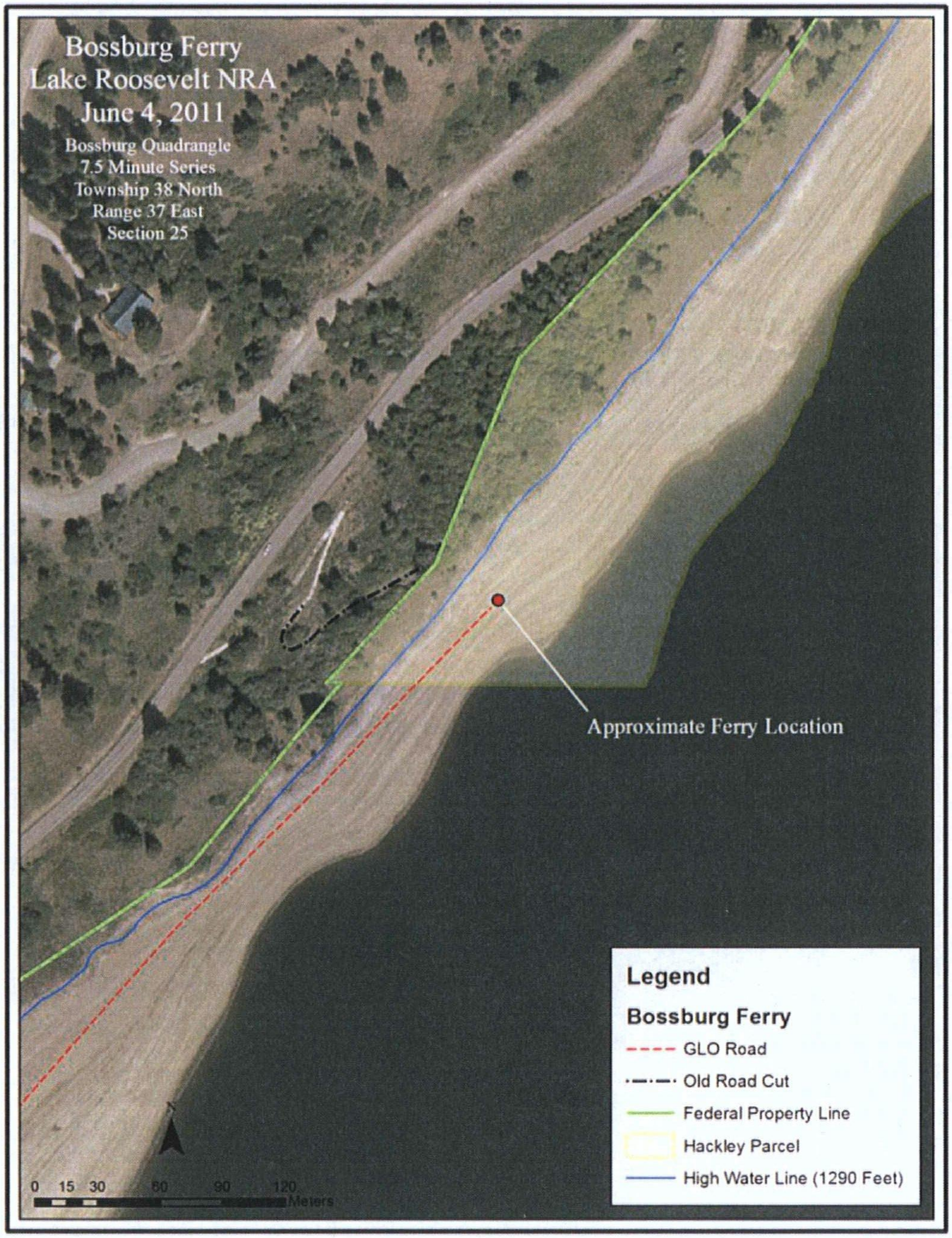

Figure 2 West Bank across from Bossburg Townsite

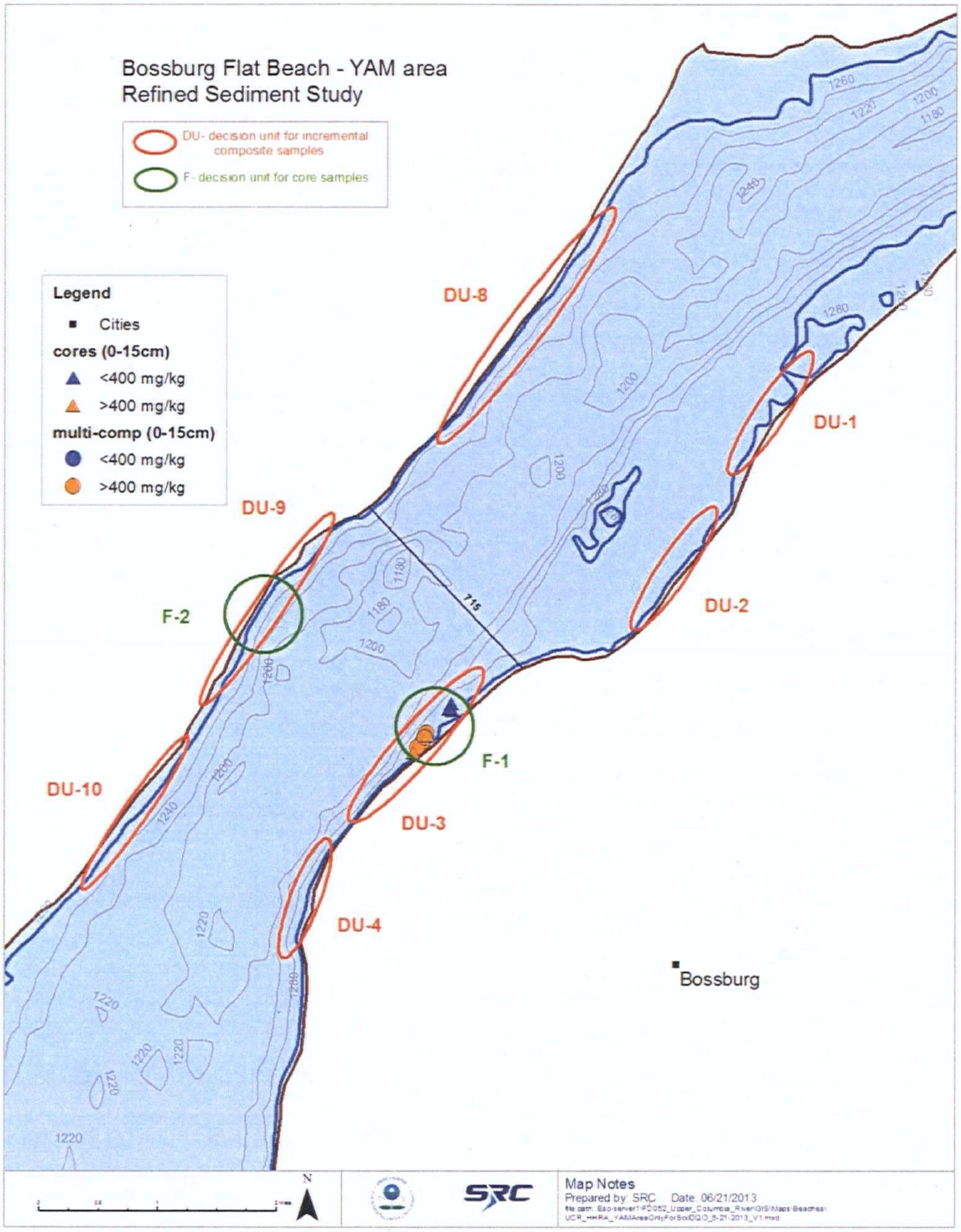

Figure 3. Young American Mill Site Sediment and Soil Sampling DUs.

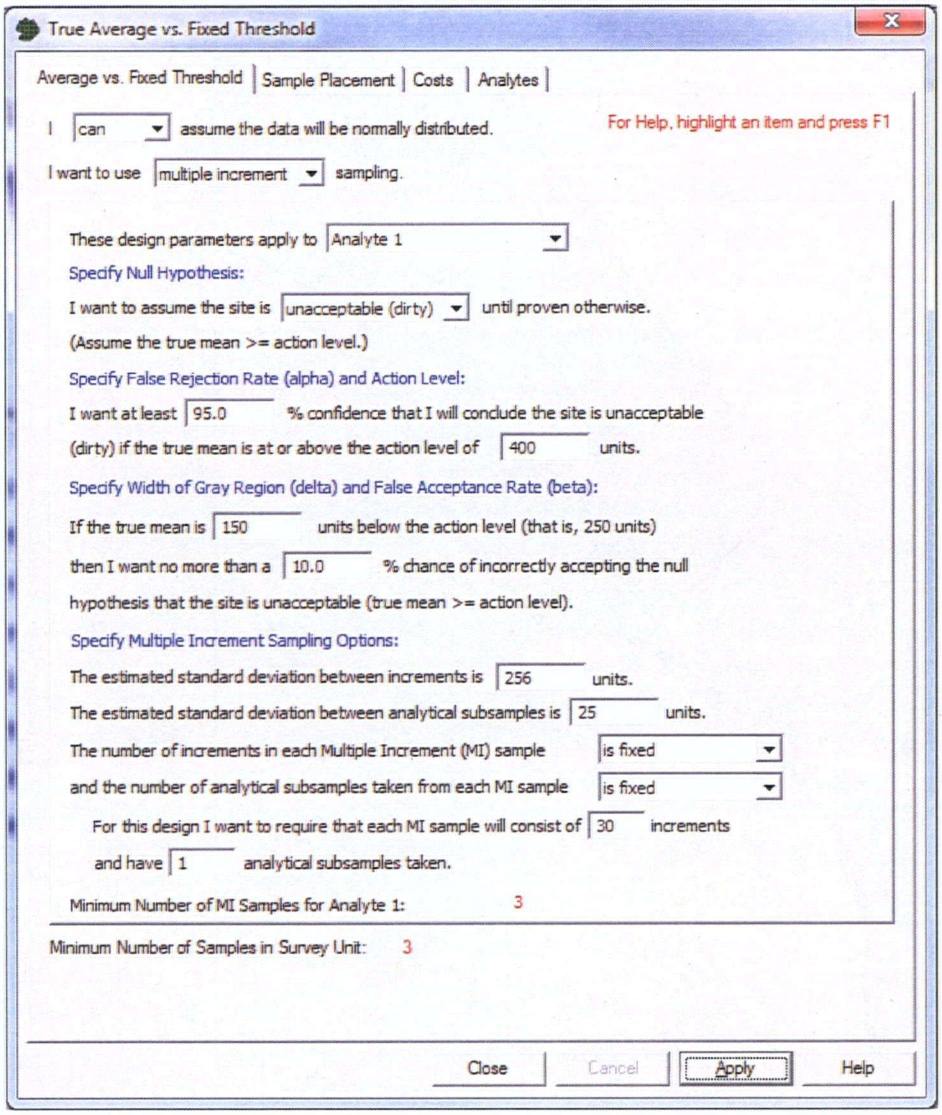

Figure 4. Screen capture from Visual Sampling Plan, Version 6.3 (VSP Development Team, 2013), indicating 3 ICS samples are sufficient to determine if the mean concentration exceeds 400 mg/kg. The null hypothesis is the lead concentration in the <250μm grain size fraction exceeds 400 mg/kg.